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C.F.

December 1, 1947

This document has been approved for release to the public by:

David R Hamrin 2/6/95
Technical Information Officer, ORNL Site — Date

CLINTON LABORATORIES
CENTRAL FILES NUMBER
47-12-116

To: R.H. Firminhac

From: T.H.J. Burnett

In Re: Measurement Method For White Oak Dam Discharge Volume

Purpose:

Accurate data on the volume of water being discharged over White Oak Dam will be of value from two chief aspects. First, knowing the volume of discharge as a function of time, and having determined by our sampling the activities per unit volume at particular times, it is possible to closely estimate the total quantity of radioactive material released into the Clinch River and Watts Bar Reservoir. With suitable constant monitoring equipment in use at White Oak Dam as contemplated, after careful caliberation an exact continuous record of total activity escaping will be obtained.

The second use for this data will be in correlation with rainfall values and the known watershed area to determine the fraction of rainfall running off into White Oak Creek, noting its variations with intensity and duration of rain, so as to have data for properly estimating the dilution obtained in the White Oak drainage area of the Settling basin discharge. For the evaluation of

CLASSIFICATION CANCELLED
J Morgan 1-18-95
ADD signature Date
Single review of CCRP-declassified documents was authorized by DOE Office of Declassification memo of August 22, 1994.

"This document contains [redacted] the meaning of the Atomic [redacted] 50 [redacted] as amended. Its transmission or the revelation of its [redacted] and may [redacted] penalty".

[redacted]

rainfall runoff, the dam discharge volume will need to be corrected by the amount of water pumped from the Clinch River.

This report describes the apparatus used in making the measurements of discharge volume, the caliberation of this apparatus and the computations of flow rate from the data obtained.

Apparatus and Measurements:

The apparatus used in obtaining data for dam discharge flow rates is shown schematically in Figure I, attached. The level of the water in the lake is recorded on a clock driven Bristol recorder where an inked pen traces a line on a chart. The chart runs for seven days and the line traced is farther from the center as the lake level increases. The height of the top of the upper gate over which the water discharges is indicated by a pointer which is opposite a gauge board marked so as to show the extent to which the upper gate is open. Zero on the gauge board indicates the upper gate to be entirely closed and its top at elevation 750.0 ft. above sea level.

Caliberation

To get data on the values of "h", the lake level was allowed to increase by closing the gate and as the level rose from day to day the gate was lowered until just even with the water then raised back up. This gave data on the position of the gate as shown on

[redacted]

the gauge board, compared with water level indications shown on the chart. This data was taken over the period from September 29, 1947 through October 16, 1947 and when plotted gave a linear relationship shown in Figure 2 attached. Values checked were between an initial relationship of 4.65 gauge board reading to which the chart value of 34.0 divisions corresponded and a final value of 2.20 gauge board corresponding to 58.0 divisions. In Figure 2 each particular data point has not been indicated to avoid confusion in the use of this resultant graph for computation, and the straight line has been extended beyond the range of the points checked, assuming continued linearity in the extrapolation range.

Computation

An engineering equasion (which may be verified by integration) gives the volume of flow, F, in cu. ft. per sec. as:

$$(1) \quad F = 2/3\ b\ h^{3/2} \sqrt{2\ g}$$

where g is the acceleration of gravity, which for this latitude is 32.15 ft/sec^2 and b and h are the width of the opening and the height of water in feet. For this application b is constant at 4 feet and h is as shown on Figure I. Knowing the position of the top of the gate from the gauge board reading, and the water level from the chart, which can be converted to its equivalent gauge board value, the difference gives the value of h. Using the known values for the constants in equasion (1) we get

$$(2) \quad F = 2/3 \cdot 4 \cdot h^{3/2} \sqrt{2 \cdot 32.15}$$

[redacted]

(3) $F = 21.4\ h^{3/2}$ cu. ft./sec.

For convenience in computation, a plot was made of h versus $h^{3/2}$ on four scale semi-log paper and is included as Figure 3.

As an illustrative computation consider chart values from midnite November 11 of 50.7 to midnite November 12 of 47.3. During this time the gate was constant in position at 4.0. The average chart reading was 49.0 which corresponds, from Figure 2, to a gate position of 3.15. The value of h by difference then is .85 feet. From Figure 3 the value of $h^{3/2}$ can be read as .78 and this when put in equasion 3 gives:

(4) $F = 21.4 \times 0.78 = 16.7$ cu.ft./sec.

This is the equivalent of 10.8 million gallons per day.

T.H.J. Burnett

THJB:rr

cc:
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2. K.Z. Morgan
3. F. Western
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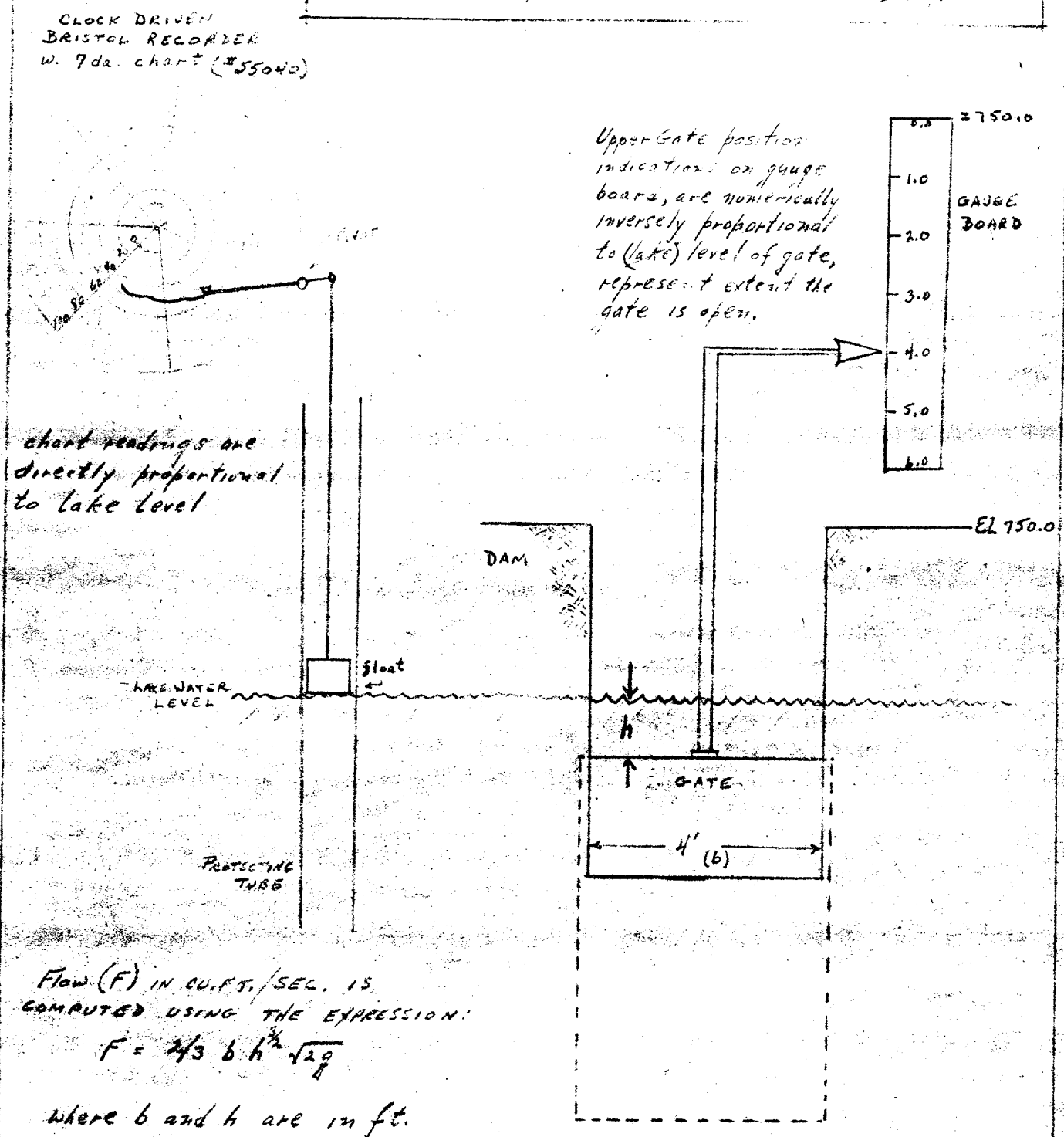
11. R.G. Lawler
12. M.M. Lingerfelt
13. Central Files
14. Reading Files

[redacted]

SIMPLIFIED SCHEMATIC DIAGRAM OF APPARATUS USED TO DETERMINE FLOW RATE AT WHITE OAK DAM.



Flow (F) IN CU.FT./SEC. IS COMPUTED USING THE EXPRESSION:

$$F = \frac{2}{3} b h^{\frac{3}{2}} \sqrt{2g}$$

where b and h are in ft.

FOR THIS GATE $b = 4$

AT THIS LATITUDE $g = 32.15$

This Drawing Classified As

UNCLASSIFIED

Per H. J. Barnett

EXPLANATORY WORKING SKETCH DAM DISCHARGE MEASUREMENTS		
CLINTON NATIONAL LABORATORY HEALTH PHYSICS DIVISION		
NOT TO SCALE	DRAWN BY: T.H.J. Burnett	DATE: 26 Nov. '47

FIGURE 1.

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By: [illegible]

WATER LEVEL
WHITE OAK DAM
CHART READINGS VS
EQUIVALENT GATE HEIGHT

UPPER GATE EQUIVALENT POSITION

0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75

BRIDGE LEVEL CHART READING

CHART # 550440

FIGURE

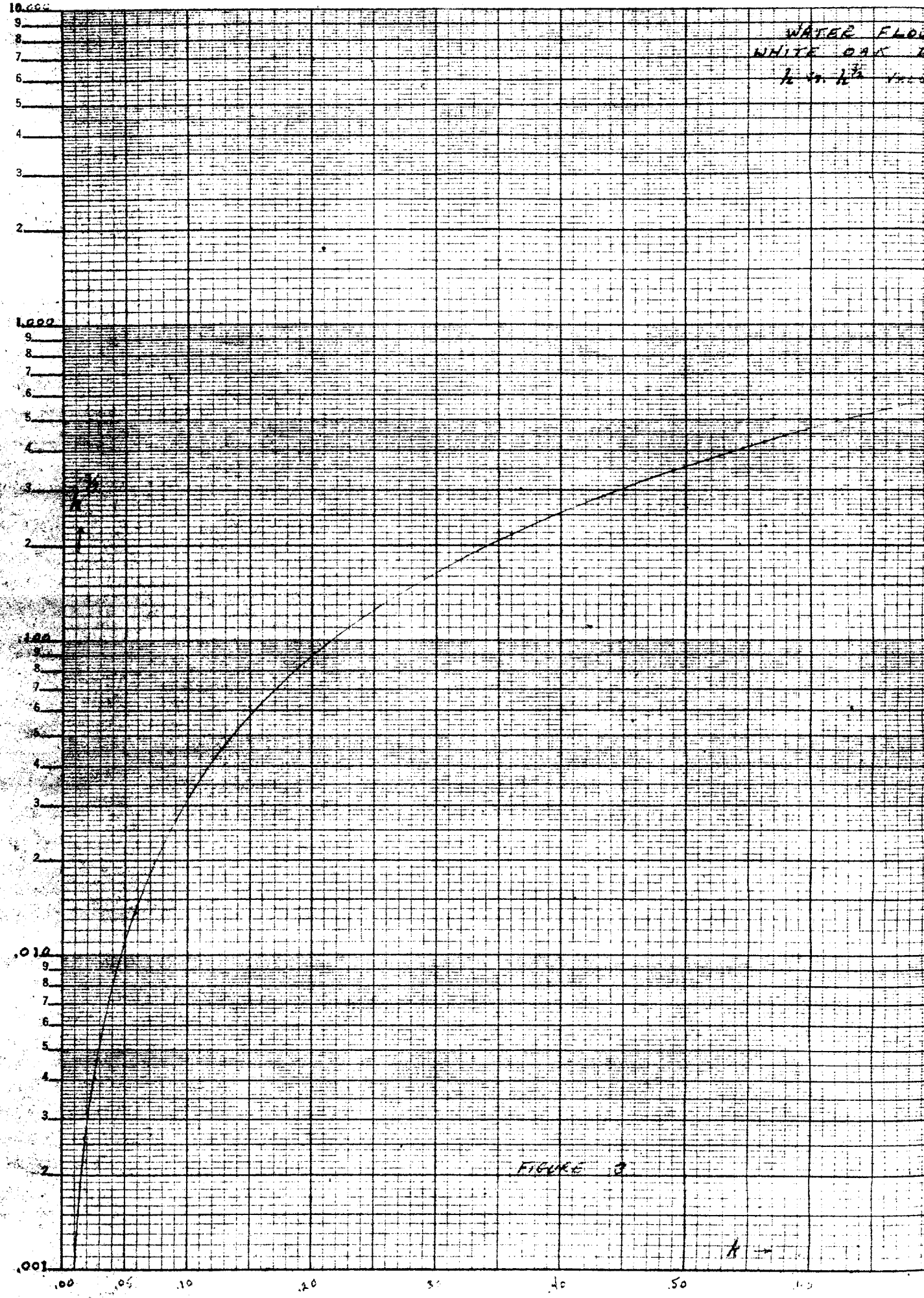
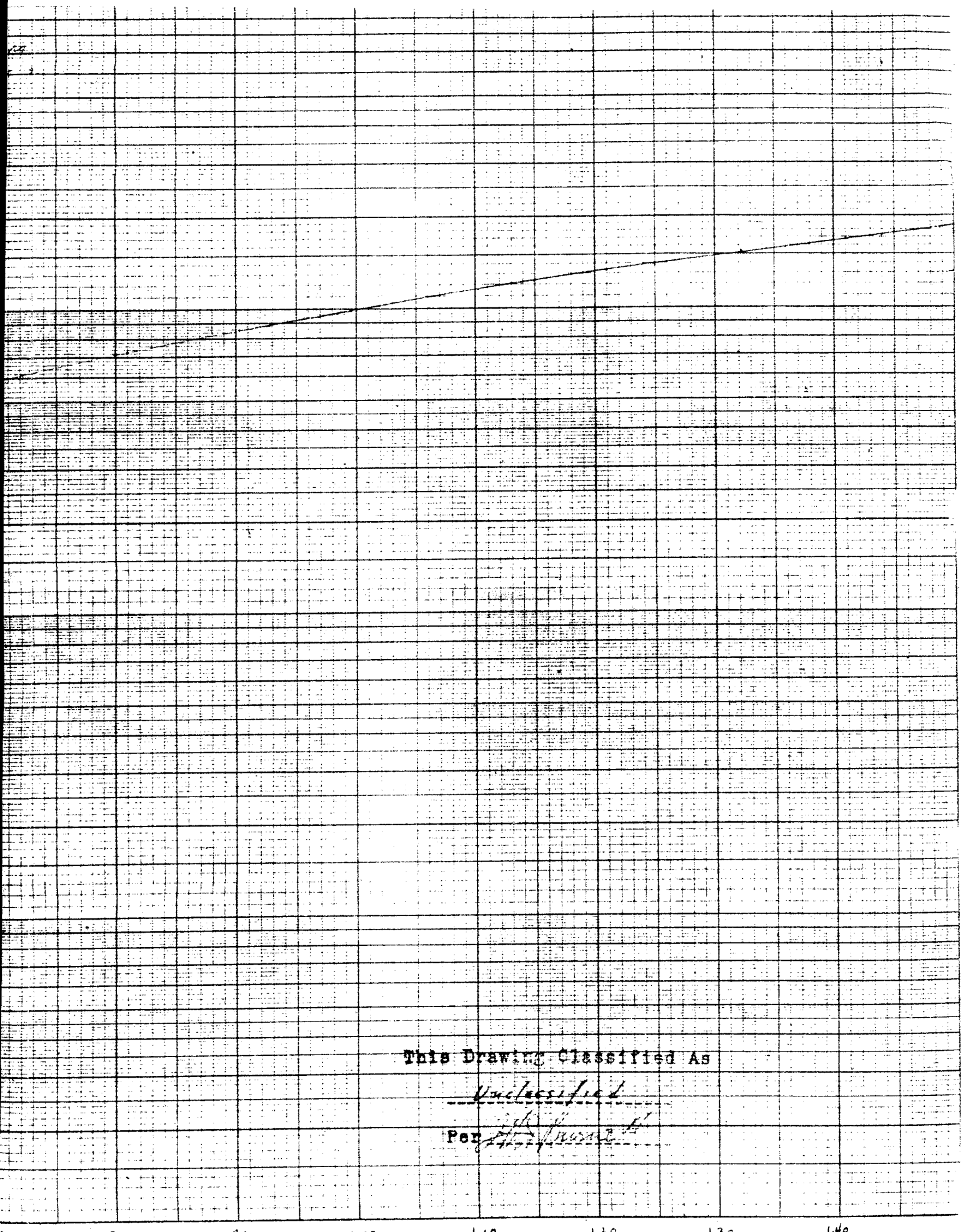


FIGURE 3

KEUFFEL & ESSER CO., N. Y. NO. 359-61LO
4 cycles X 10 to the inch, 5th lines accented.
MADE IN U.S.A.



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Per [illegible]